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The challenge of increasing production of the animal sector while reducing its environmental footprint

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Abstract
Associated with a continuous decrease in the number of hungry people, studies looking at future trends predict an increase of world population over the next 30 years. These demographic changes are related to an increase in their buying power, essentially in emerging countries such as China, Brazil, India, Indonesia and to a lesser extent Africa. This increased population with more money to spend will provoke a dramatic increase in animal product consumption (meat, milk and fish) in these emerging countries. At the same time, industrial countries will probably reduce their meat consumption per capita for a variety of reasons, which, coincident with stagnation of their population growth, will probably lead to decreased meat consumption in these countries. Simultaneously, the demand for animal products with high nutritional, organoleptic and « ethic » qualities will increase all over the world. This « ethic » quality is a new concept coming from old Europe and is related to livestock production in specific areas where the conditions of production, i.e. use of local feeds of known origin, respect of animal welfare, reduced use of antibiotics, reduced environmental footprint, etc., are considered to be a significant part of product quality, which adds, rather than substitutes, to their organoleptic and nutritional values. This concept has emerged in Europe where the environmental footprint of livestock farming systems is now obvious, at either a global (essentially via Green House Gases (GHG) emissions), a regional (Ammonia in the air), or at a local scale (Nitrates in water and manure odours). These global and local challenges can be, and should be, tackled at both global and local levels. I will develop below the examples of GHG emissions and of the use of antibiotics, but the same rationale could be used for other externalities.
Key words: livestock production; meat consumption; environmental footprint; animal welfare.

Resumen
Asociados con una disminución continua en el número de personas que padecen hambre, los estudios que analizan las tendencias futuras predicen un aumento de la población mundial en los próximos 30 años. Estos cambios demográficos están relacionados con un aumento en su poder de compra, esencialmente en países emergentes como China, Brasil, India, Indonesia y, en menor medida, en África. Este aumento de la población con más dinero para gastar provocará un aumento dramático en el consumo de productos animales (carne, leche y pescado) en estos países emergentes. Al mismo tiempo, los países industriales probablemente reducirán su consumo de carne per cápita por una variedad de razones que, junto con el estancamiento del crecimiento de su población, probablemente conducirán a una disminución del consumo de carne en estos países. Simultáneamente, la demanda de productos animales con altas cualidades nutricionales, organolépticas y de "ética" aumentará en todo el mundo. Esta calidad «ética» es un concepto nuevo que proviene de la vieja Europa y está relacionado con la producción ganadera en áreas específicas donde las condiciones de producción, es decir, uso de alimentos locales de origen conocido, respeto del bienestar animal, uso reducido de antibióticos, disminución de la huella ambiental, etc., se consideran una parte importante de la calidad del producto, que agrega, en lugar de sustitutos, a sus valores organolépticos y nutricionales. Este concepto ha surgido en Europa, donde la huella ambiental de los sistemas ganaderos es ahora evidente, ya sea a nivel global (esencialmente a través de las emisiones de gases de efecto invernadero), regional (amoníaco en el aire) o a escala local (nitratos en el agua y los olores del estiércol). Estos desafíos globales y locales pueden y deben ser abordados tanto a nivel global como local. A continuación desarrollaré los ejemplos de emisiones de GEI y del uso de antibióticos, pero la misma razón podría usarse para otras externalidades.

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Palabras clave: producción ganadera; consumo de carne; huella ambiental; bienestar de los animales.

Introduction

Associated with a continuous decrease in the number of hungry people, studies looking at future trends predict an increase of world population over the next 30 years. These demographic changes are related to an increase in their buying power, essentially in emerging countries such as China, Brazil, India, Indonesia and to a lesser extent Africa. This increased population with more money to spend will provoke a dramatic increase in animal product consumption (meat, milk and fish) in these emerging countries. At the same time, industrial countries will probably reduce their meat consumption per capita for a variety of reasons, which, coincident with stagnation of their population growth, will probably lead to decreased meat consumption in these countries (Paillard et al. 2011, Ronzon et al. 2011, Searchinger et al. 2013). Simultaneously, the demand for animal products with high nutritional, organoleptic and « ethic » qualities will increase all over the world. This « ethic » quality is a new concept coming from old Europe and is related to livestock production in specific areas where the conditions of production, i.e. use of local feeds of known origin, respect of animal welfare, reduced use of antibiotics, reduced environmental footprint, etc., are considered to be a significant part of product quality, which adds, rather than substitutes, to their organoleptic and nutritional values. This concept has emerged in Europe where the environmental footprint of livestock farming systems is now obvious, at either a global (essentially via Green House Gases (GHG) emissions), a regional (Ammonia in the air), or at a local scale (Nitrates in water and manure odours) (Peyraud et al. 2014).

The value of the environment has also increased, as it is perceived as a source of positive values, for example, remembering the good old times when parents lived in the countryside, and because it provides recreational and aesthetic benefits to urban or rural citizens. In this context, citizens are increasingly aware of the negative impacts of livestock farming systems such as water pollution, decrease of biodiversity, or degradation of air quality.

In recent years, the perspectives of climate change have become more pronounced and the expected local consequences of these changes in zones of high human density could be extremely severe. This can be assessed from the observed or expected increase in the frequency of abnormal local climatic events, increase in green algae proliferation at the seashore, and biodiversity losses in many anthropized ecosystems. These consequences that anyone can observe around one's home location reinforce the impression of an impact of animal production systems on climate change.

Finally, in industrialized countries, green lobbies play a role in criticizing livestock production systems, asking consideration of farm animals as « animal beings » and denouncing (in some cases with good reason) welfare conditions on farms and slaughtering conditions. These criticisms are reinforced by the distance between citizens and farm animals, since more than half of the worldwide population now lives in cities, in which livestock species are replaced by pets, at least in industrialized countries.

Challenges

These global and local challenges can be, and should be, tackled at both global and local levels. I will develop below the examples of GHG emissions and of the use of antibiotics, but the same rationale could be used for other externalities.

In 2012, livestock produced about 16% of global GHG emissions, among which 10% are from enteric CH4, essentially from bovine, and 6% from manure (Figure 1, FAO 2014). Livestock represented about 2% of the world's GDP (75x1012 US $). In 2050, if all other sectors reduce their emissions by 70%, especially energy and transportation (which may be easier to accomplish), then the livestock sector would be responsible for 40% of global GHG emissions. This would represent a tremendous ecological and socioeconomic pressure for a sector accounting for less than 2% of the world's economy. Moreover, these projections are done with a global warming potential over a 100-year period between CO2 and Methane (CH4) of 28, whereas,

some scientists propose to re-evaluate this coefficient in the future, increasing it to 84 for a 20-year period (Myrhe et al. 2013).

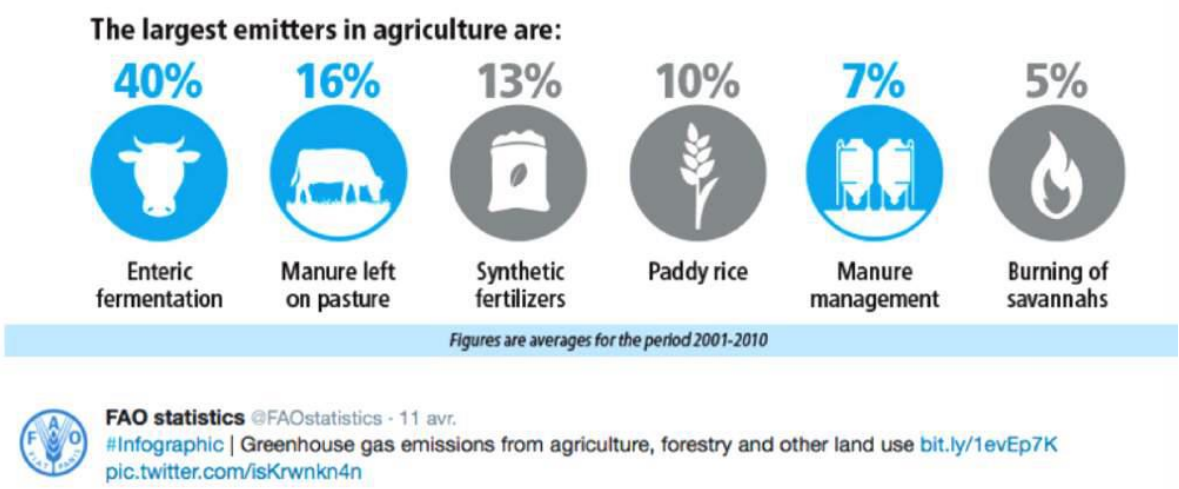

Figure 1. Sources of Green House Gases in agriculture (FAO 2014)

Emissions should be reduced per unit of animal product (kg of meat and liter of milk), but also per country or production systems, if we agree that each country/production system should do the same effort as any other. This forces livestock farming systems to explore solutions for decreasing GHG emissions at different levels of the system: (1) at the territorial level by exploring complementarities between sub-territories, (2) at the farm level by exploring new systems of production which optimize positive outputs and mitigate negative impacts using a multicriteria approach, (3) at the individual level by exploring new feeding and management practices and selecting animals for a better feeding efficiency. These three levels must be explored in a systemic and holistic approach. A multidisciplinary approach is also required to propose science-based (topdown) and farmer-based (bottom-up) innovations.

Science is absolutely essential to tackle these different challenges and would be more efficient if developed simultaneously all over the world, since some questions are similar from Europe to New Zealand, from Africa to America and from Asia to Australia.

For example, organizing an efficient system of manure management at he regional level would allow better manure use by reducing the nitrogen impact on small areas with high densities of livestock, and fertilizing crops rather than using mineral fertilizers bought off-farm. This requires an important scientific and technical investment in terms of properly managing manure in order to mitigate nitrogen losses and make better use of its fertilizing properties. Organizing a whole system of manure management from the producer to the user also has socio-economic and sociologic implications.

At the farm level, research programs are clearly needed for feeding animals in optimal systems that will simultaneously reduce CH4 emissions by the rumen and N2O emissions from the manure, while utilizing feed resources that are not in competition with human food consumption. It will require a better scientific and technical knowledge of the value and availability of all sub-products, and of adequate processes to treat them for animal feeding.

At the animal level, the continuous improvement of the genetic capacities of farm animals must be pursued, but with a different balance of traits and/or breeding goals; those related to environmental footprint, such as selection for reducing enteric CH4 emission (Pickering et al. 2015) or female longevity should have an increasing weight in selection indexes combining various traits. Hopefully, genomic selection will allow professionals to achieve this goal more easily.

The use of antibiotics in livestock production has allowed tremendous progress in the cure or the

control of many bacterial diseases, improving health and welfare of animals, and therefore the safety of food products
of animal origin. An early curative treatment launched as soon as possible after the diagnosis of a disease of
bacterial origin is the best way to obtain the animal recovery.
The use of antibiotics as enhancers of growth has also allowed an increase in the efficiency of animal production for decades. However, antimicrobial resistance is an ineluctable adverse effect of antibiotics use.
Therefore, the large actual and future use in livestock animals of antibiotics which belong to the same therapeutic classes as those used in humans (Van Boeckel et al. 2015), has been progressively recognized as partly responsible for the emergence of bacterial resistance to antibiotics (ECDC 2015) and has led to a severe decrease in antibiotic efficiency in human diseases (Nachman et al. 2013). Each year in the United States, at least 2 million people become infected with bacteria that are resistant to antibiotics and at least 23,000 people die each year as a direct result of these infections (CDC 2015, O'Neill 2015). Thus, antibiotics used as growth promotors have been banned in Europe since 2006 and there is a strong effort to actually reduce their use as drugs, especially in monogastric species. In that field, some European countries have started a strong program of reduction of use of antibiotics which has allowed very significant reductions in the last few years (- 51% 2009-2012 in The Netherlands, Maran Report 2012 ; -50% 1998-2002 in Denmark, Levy 2014 ; -15% in France, Anses 2014) without any adverse effect on production and/or animal health. Many research laboratories in Europe are engaged in scientific programs, using for example pro-biotics, to replace the preventive use of antibiotics, for example in animals at risk of a disease outbreak. This research has led to the creation and development of small companies producing these new products. One of the objectives of the European Union and of FDA is to put on the market, good and healthy animal products coming from farms where the use of antibiotics is reduced to its strict minimum (Commission Notice 2015, FDA 2015). It is interesting to mention that organic farms, which are currently growing in number, have completely banned 28
antibiotics. Moreover, synergies can be found between organic farming practices and conventional farms practices to find new and sustainable techniques for controlling animal health while implementing a reduced and prudent use of synthetic antimicrobial drugs in order to protect the veterinary and the human public health, as well as the environment.

Final considerations

Developing sustainable systems is possible in terms of economy. All farmers and associated partners make a living derived from and dependent upon a healthy environment. Thus the needs to reduce the local and global impacts of livestock farming systems are inherently valuable to those groups. In terms of society, the livestock chain must provide attractive and stable jobs, which in turn depend upon thriving livestock farming systems.
The proposition of René Dubos in 1972 at the United Nations Conference on the Human Environment «Think globally, act locally », may be changed into « Think globally, act systemically » for putting the livestock sector in a better position to cope with the coming challenges. This change illustrates the need for an involvement of science and innovation at different levels of the agro-ecosystem to efficiently reduce the environmental footprint of the livestock sector. This also illustrates the need for an international network of animal scientists and industrial partners joining their efforts for solving these global and local challenges.

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